

Summary of Field Quality in D1L Dipoles

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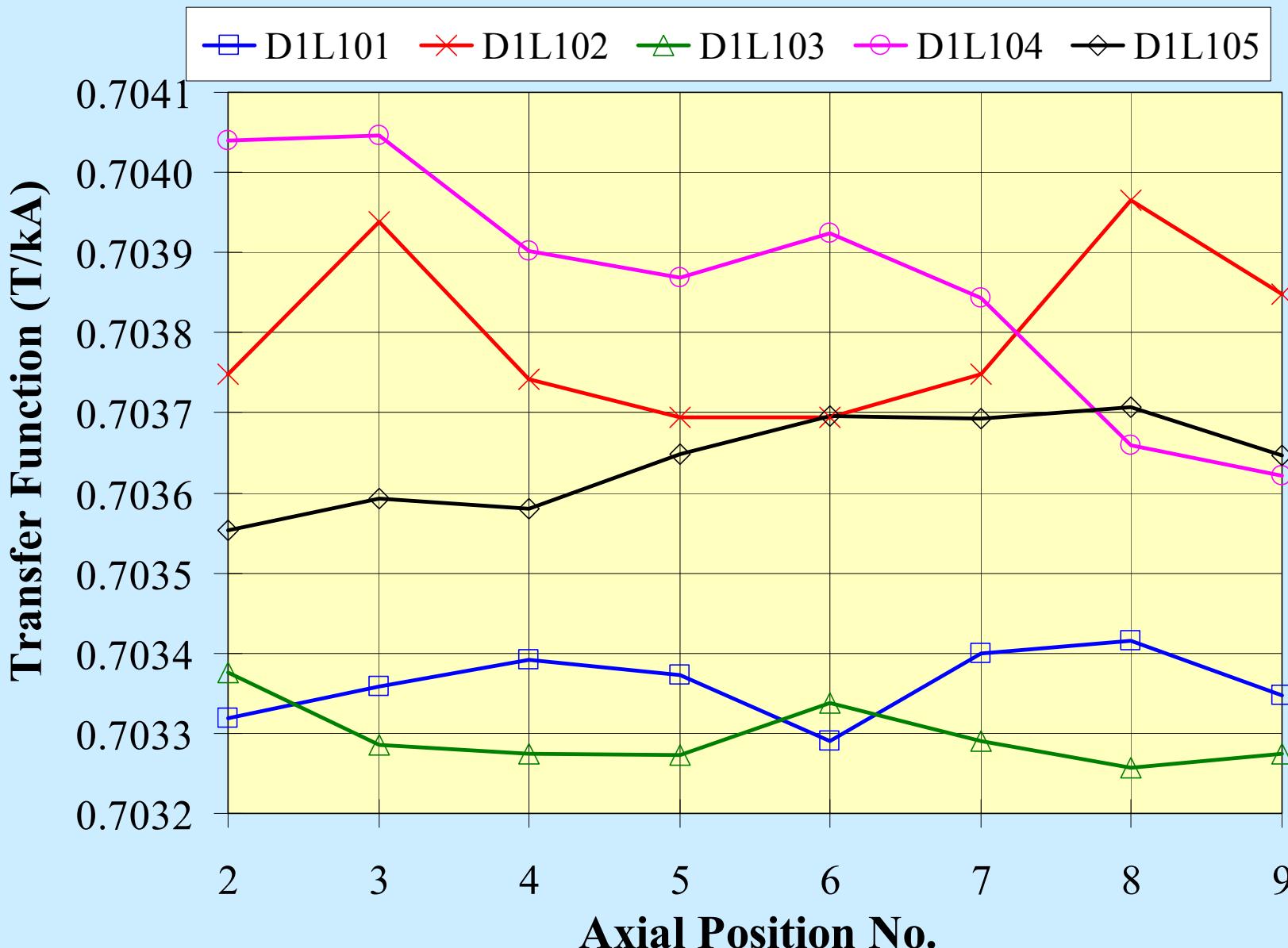
Warm Measurements in D1

- **Warm Z-scans in all D1 dipoles (D1L101-5)**
 - 10 positions; 1 meter long rotating coil
 - Field quality: “local” as well as integral
 - Field angles with respect to gravity
 - *Done after cold test*
- **Optical survey on the warm test stand**
 - Allows expressing field angles in a reference frame tied to the magnet, rather than gravity
 - Gives information on various pipe locations
- **Integral Transfer Function using long coil**
 - Non-rotating, 10-meter long coil
 - Magnet ramped from 0.5A to 30.5A at 60 A/s
 - *Most reliable ITF data to compare magnets*

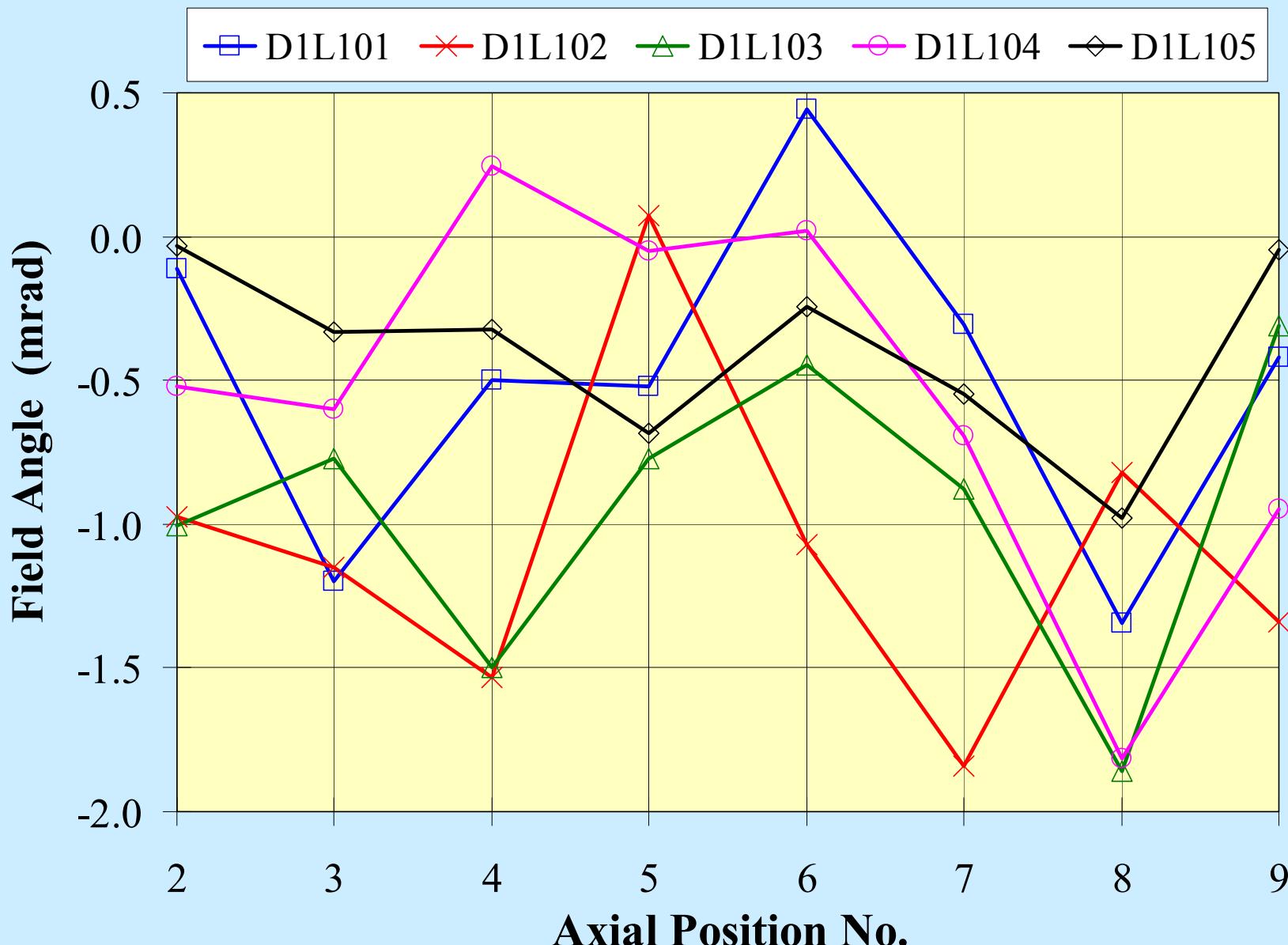
Cold Measurements in D1

- **Two magnets were measured cold**
 - D1L103 was measured in March, 2002
 - D1L101 was measured during re-test in Dec. 2003
- **DC loops with 1-m long coil**
 - 10 axial positions: “Local” & Integral fields
 - Field angle variation with current
 - Integral Transfer Function obtained by summing data from the 10 axial positions
 - Typical random error in ITF $\sim 0.1\%$ due to uncertainty in the mole axial positions
 - Warm-cold field angle change derived using warm measurements on the cold test stand

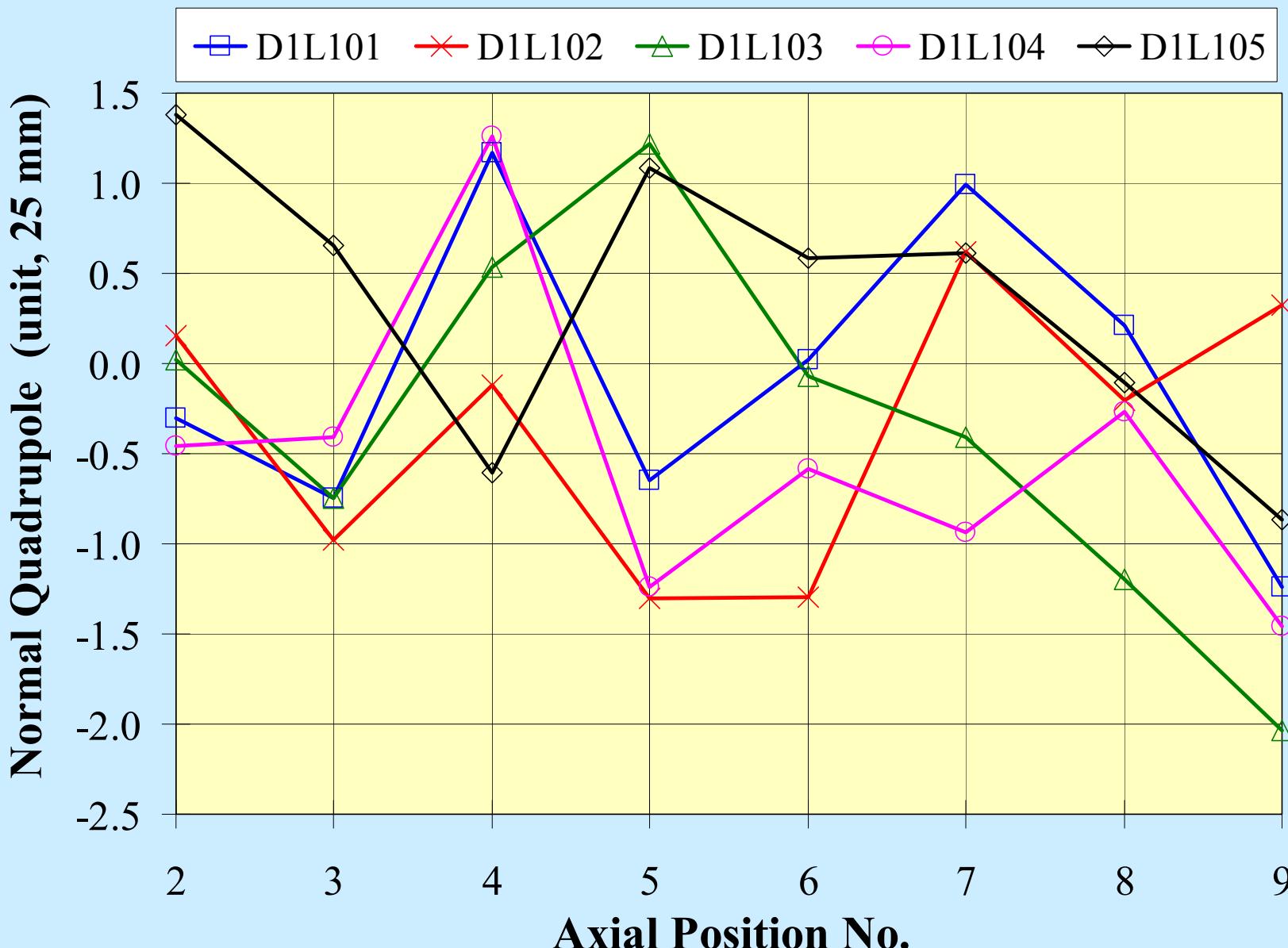
Warm Z-Scans in D1 Dipoles



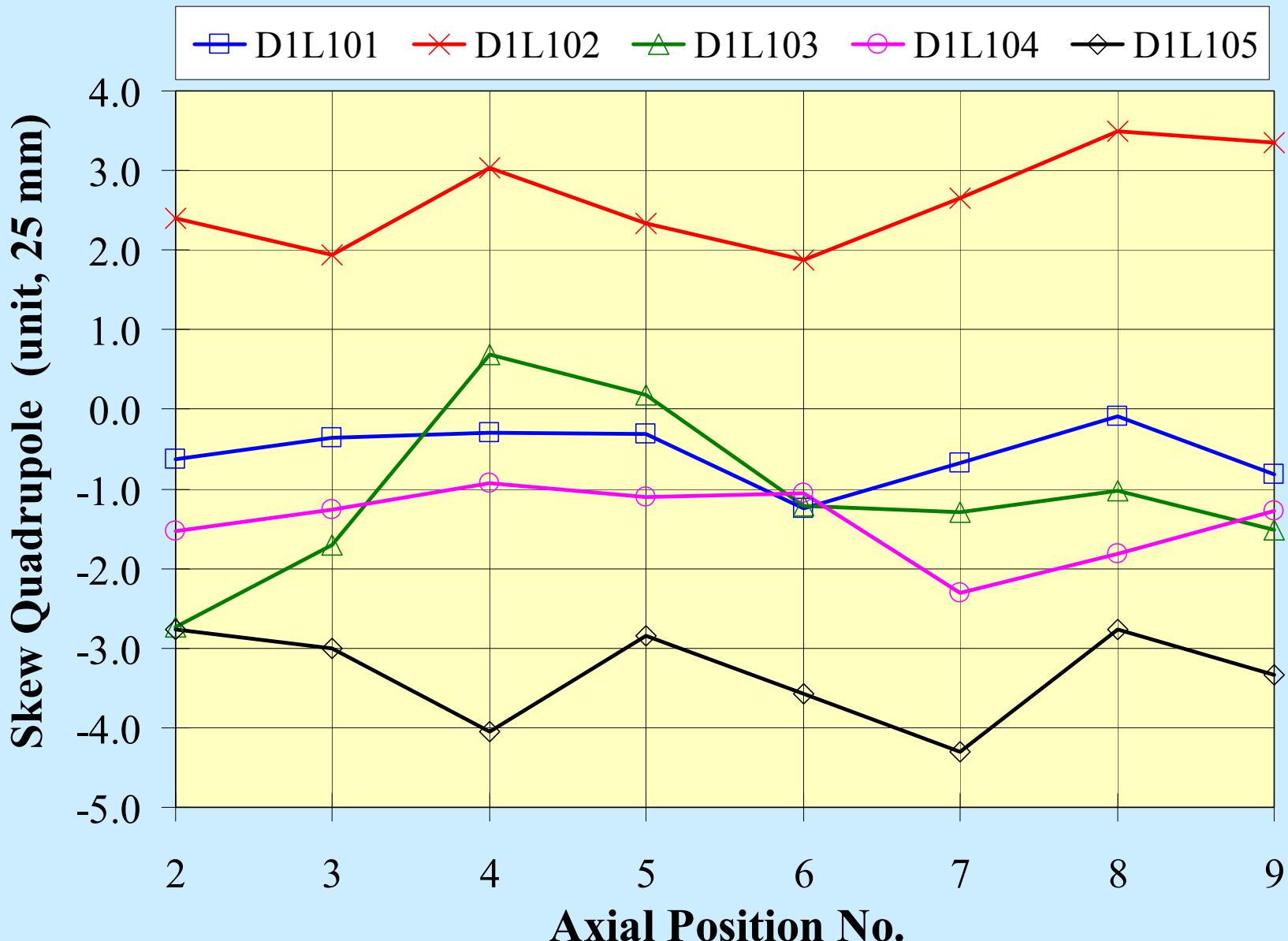
Warm Z-Scans in D1 Dipoles



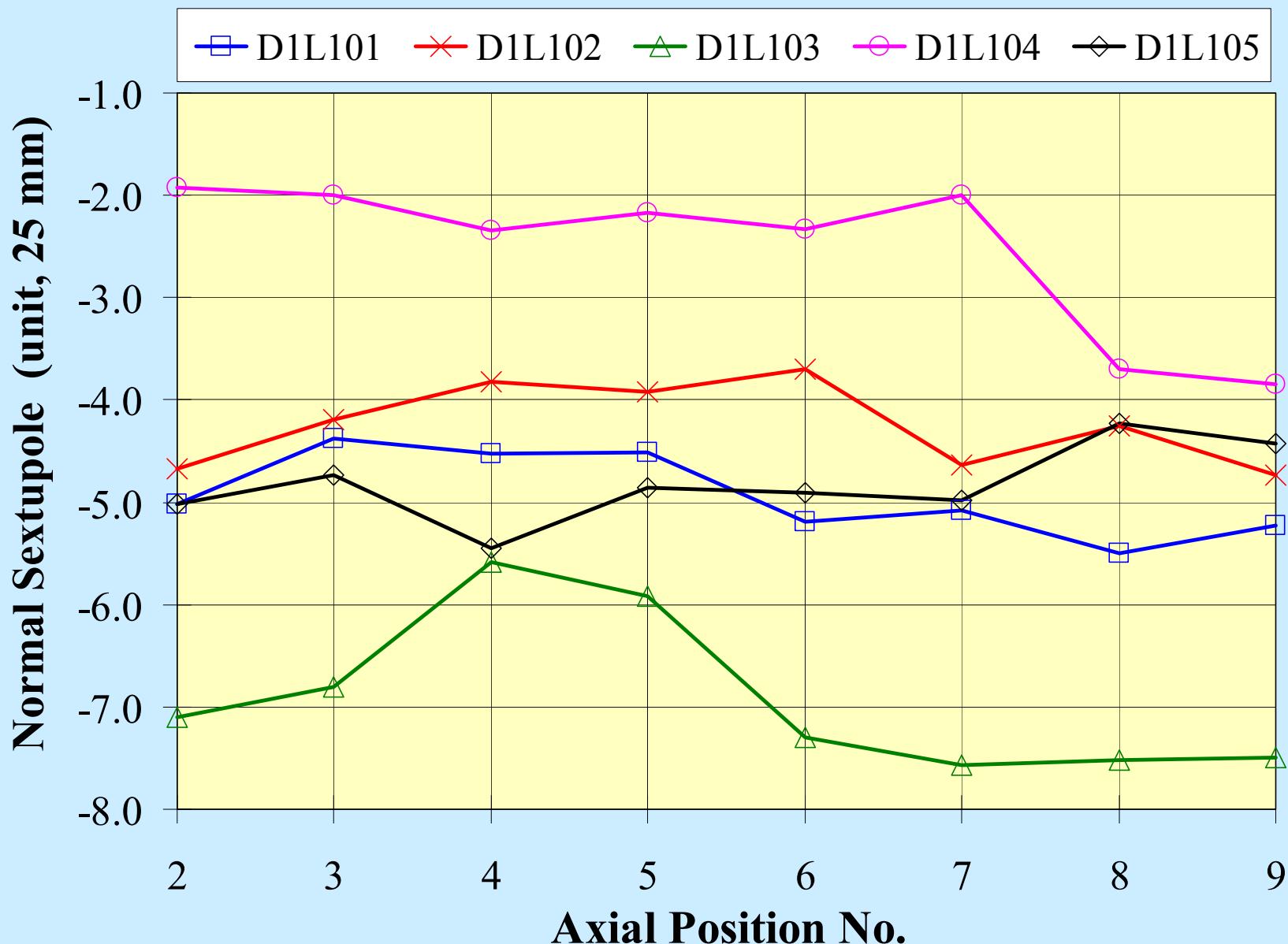
Warm Z-Scans in D1 Dipoles



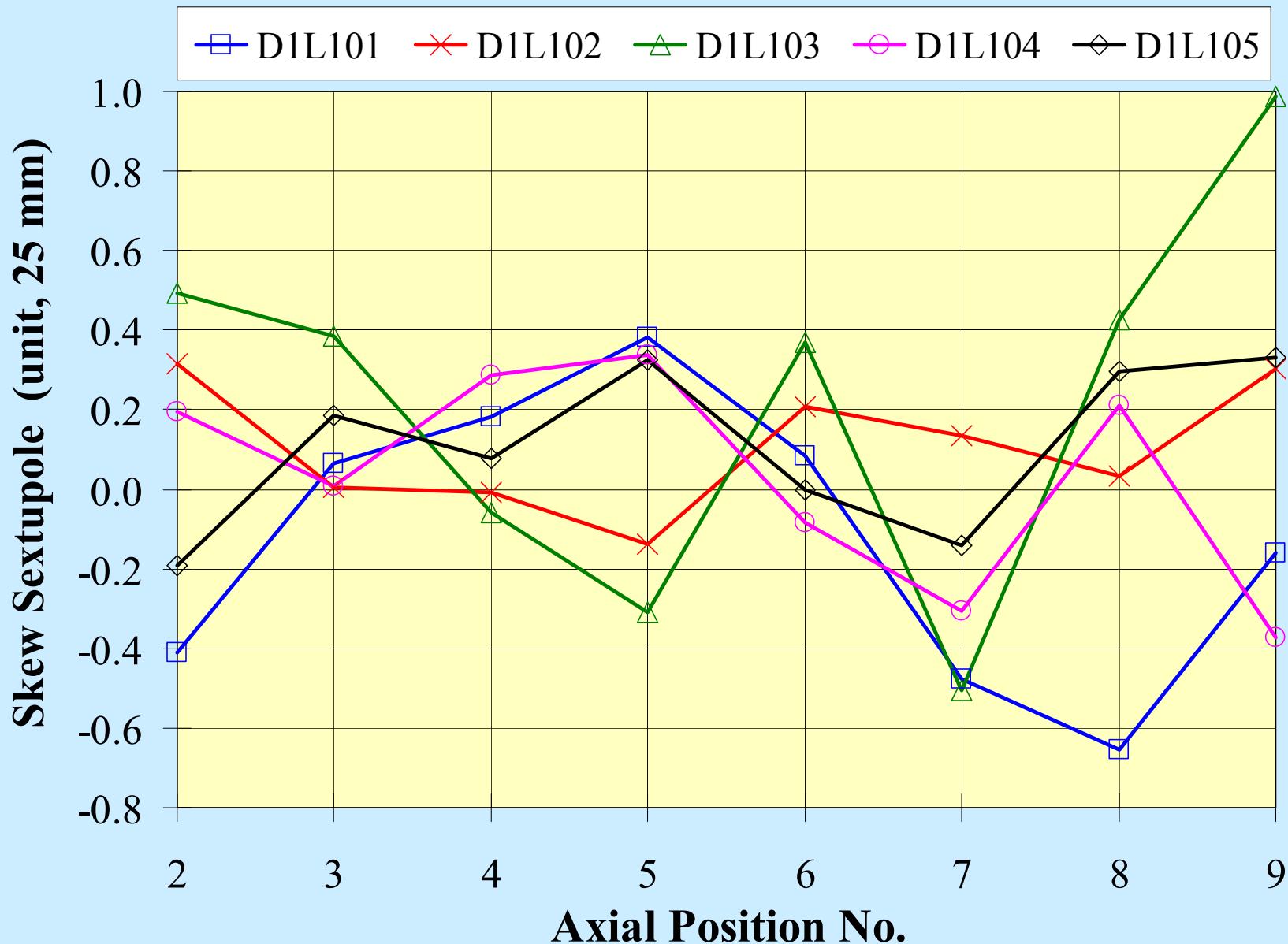
Warm Z-Scans in D1 Dipoles



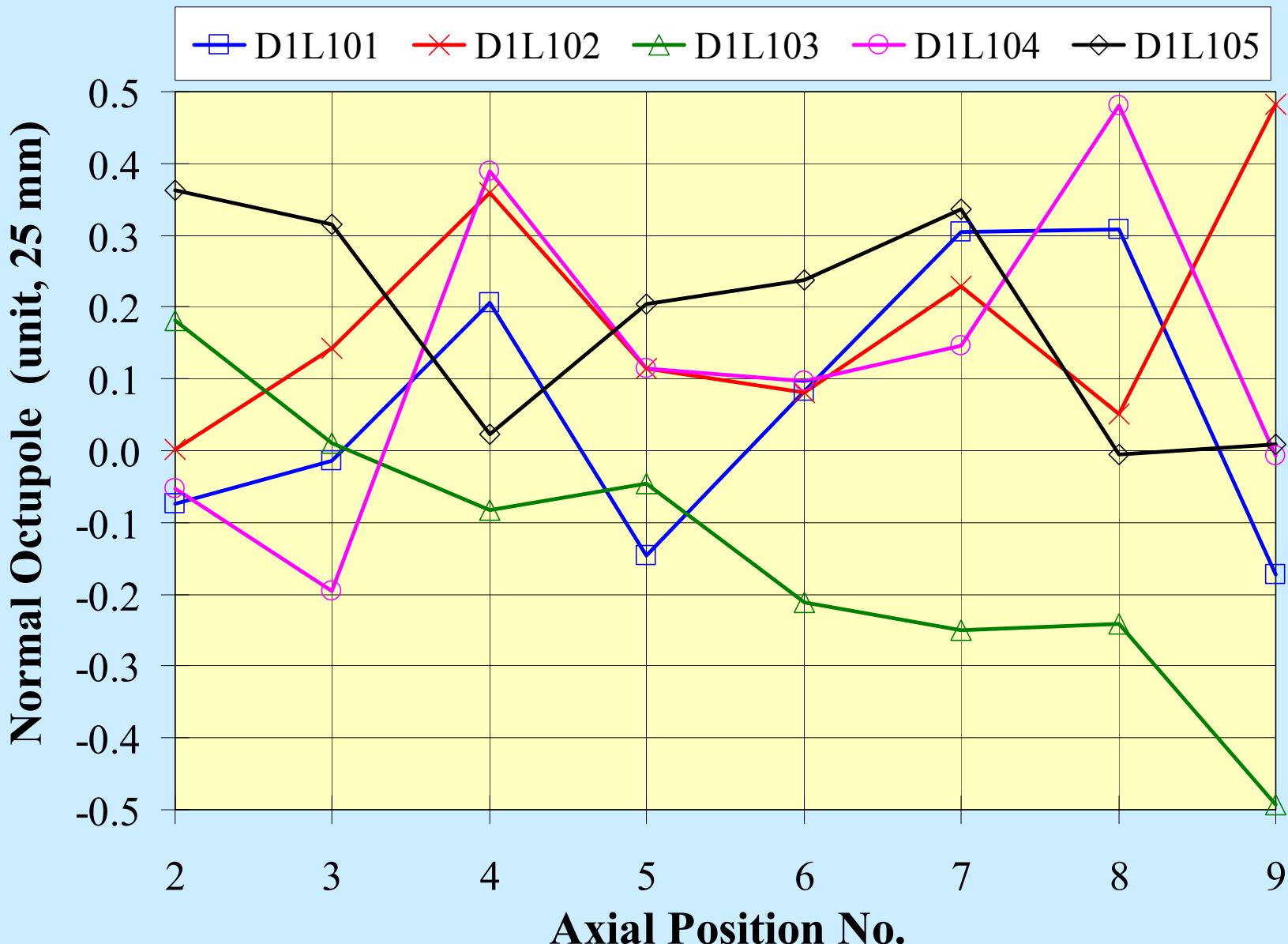
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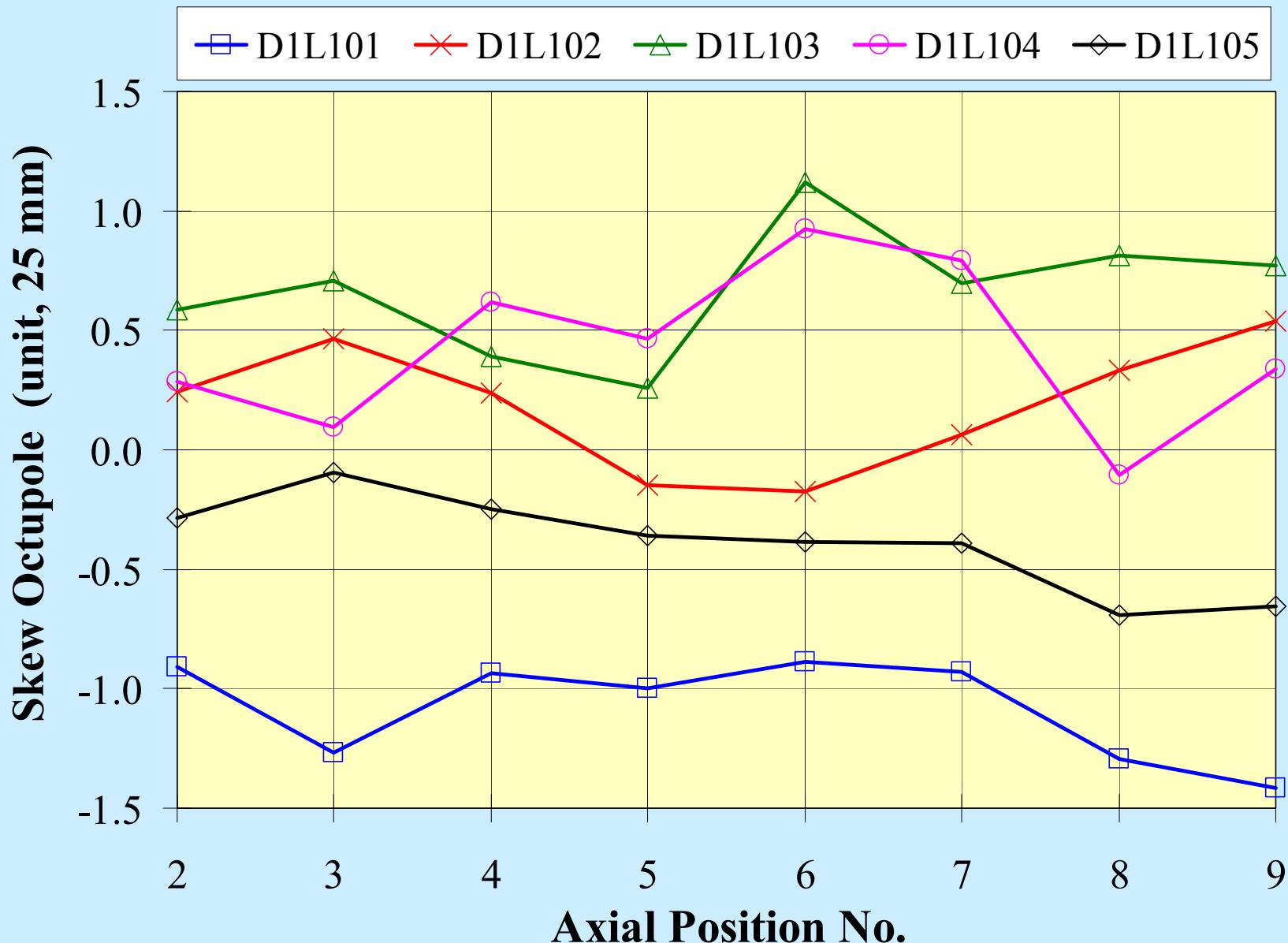
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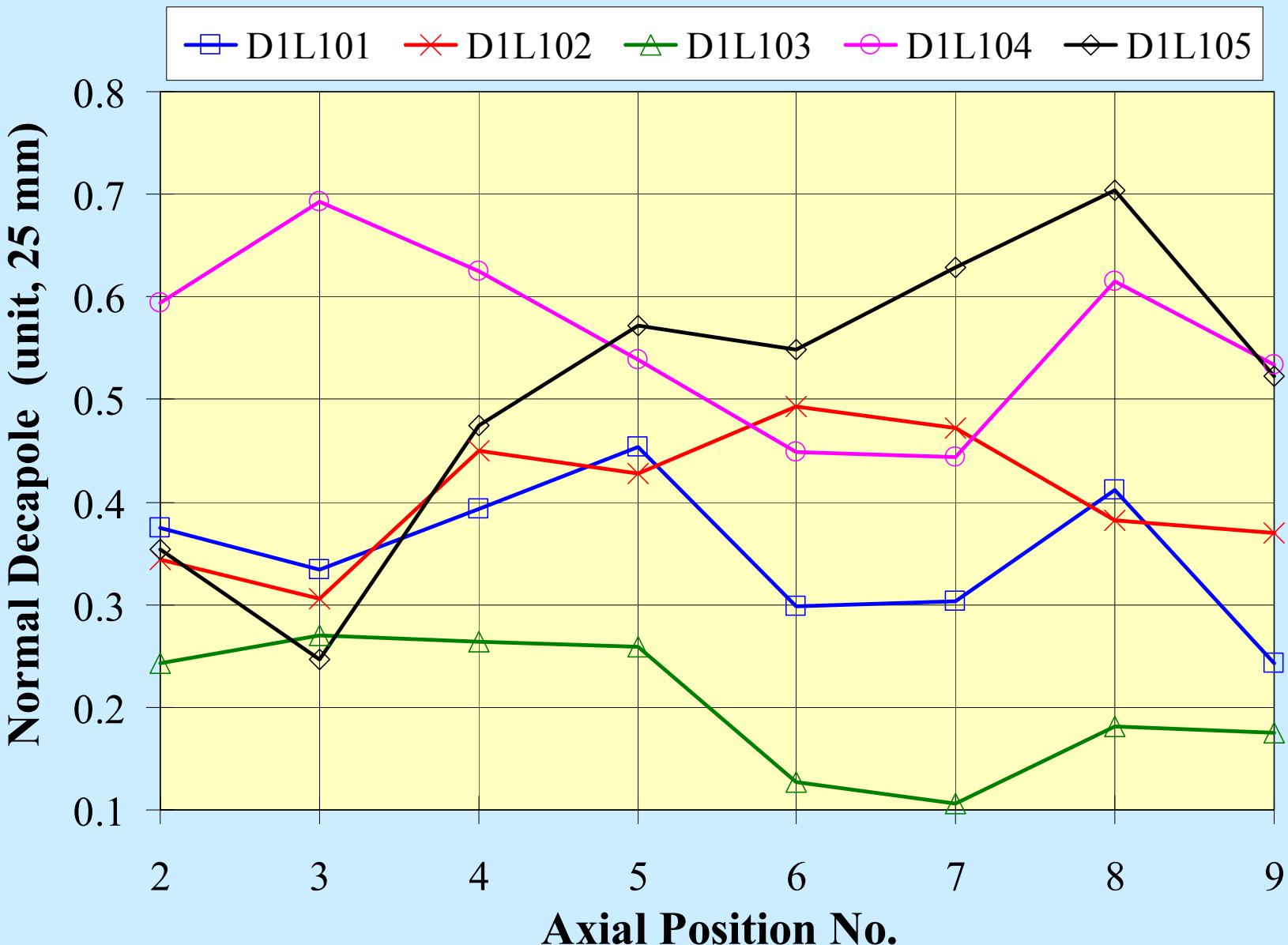
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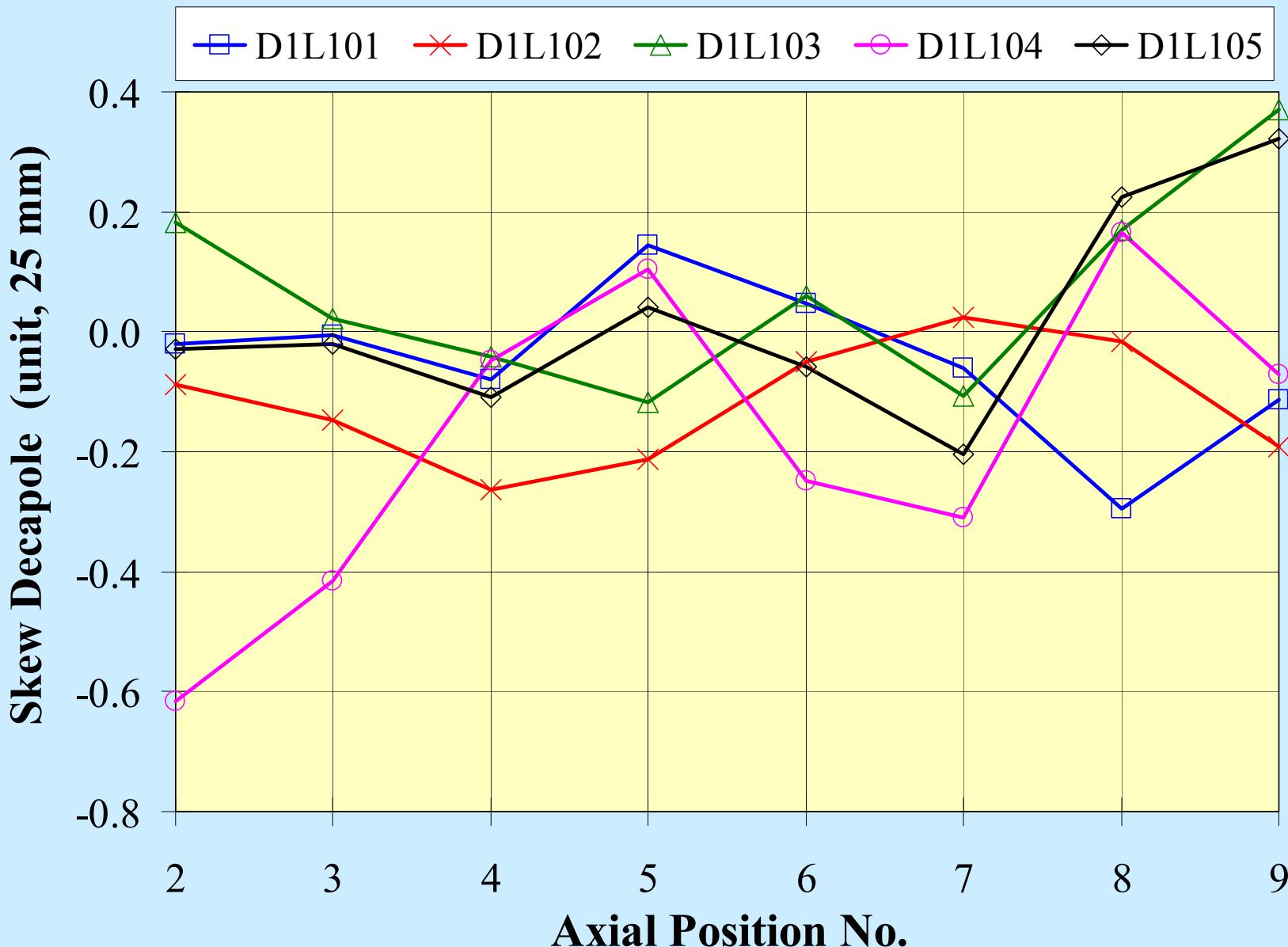
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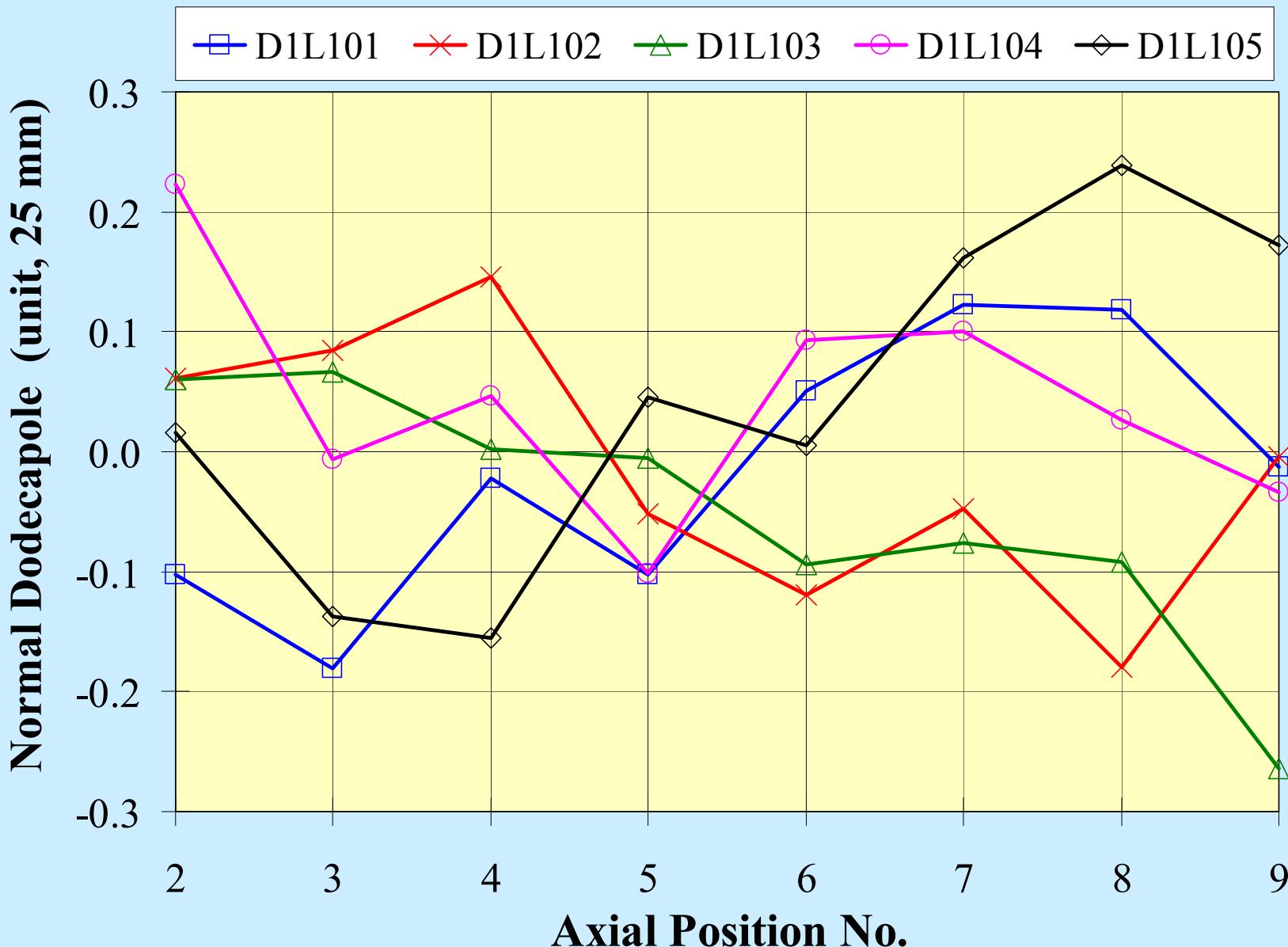
Warm Z-Scans in D1 Dipoles



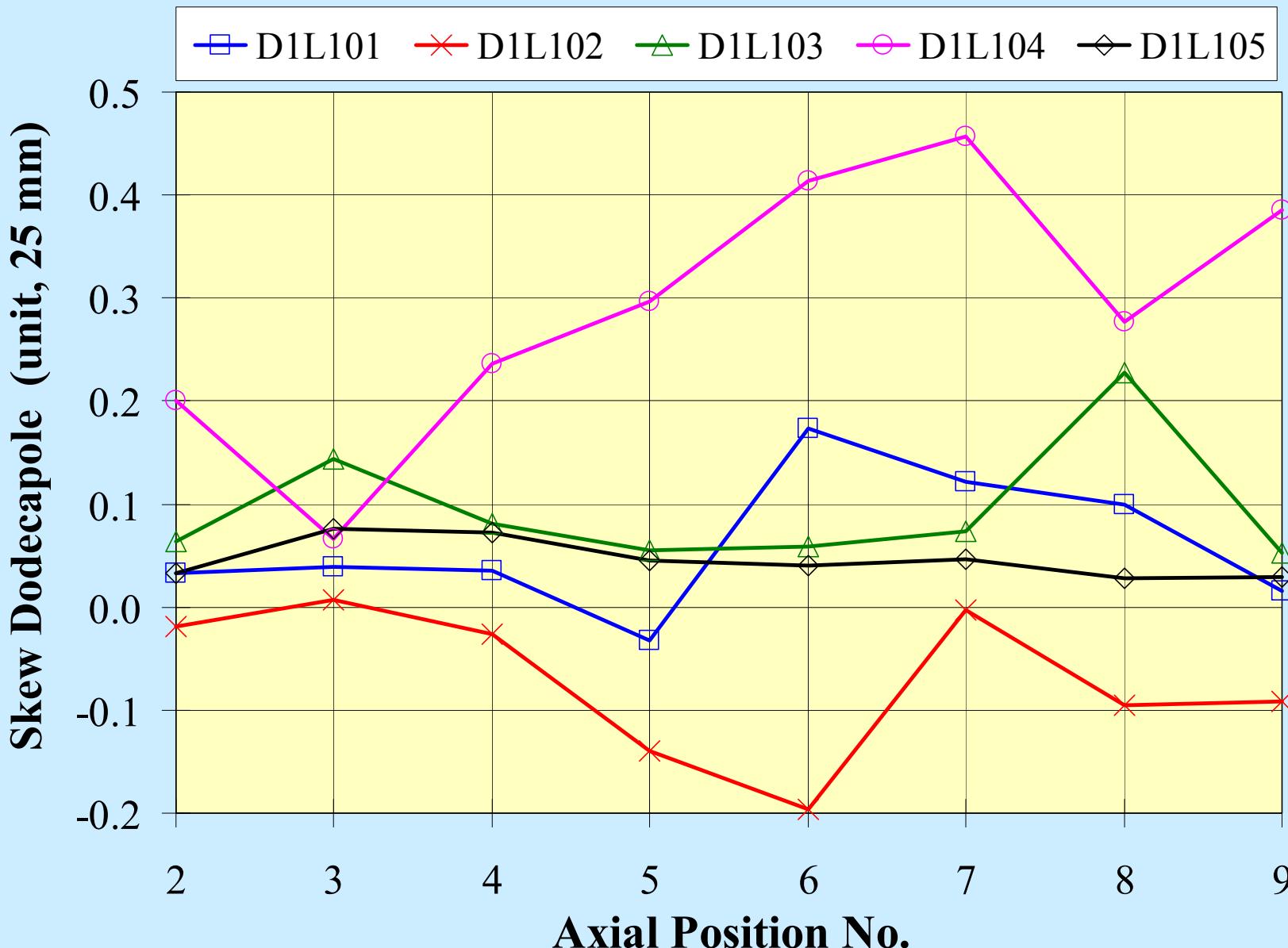
Warm Z-Scans in D1 Dipoles



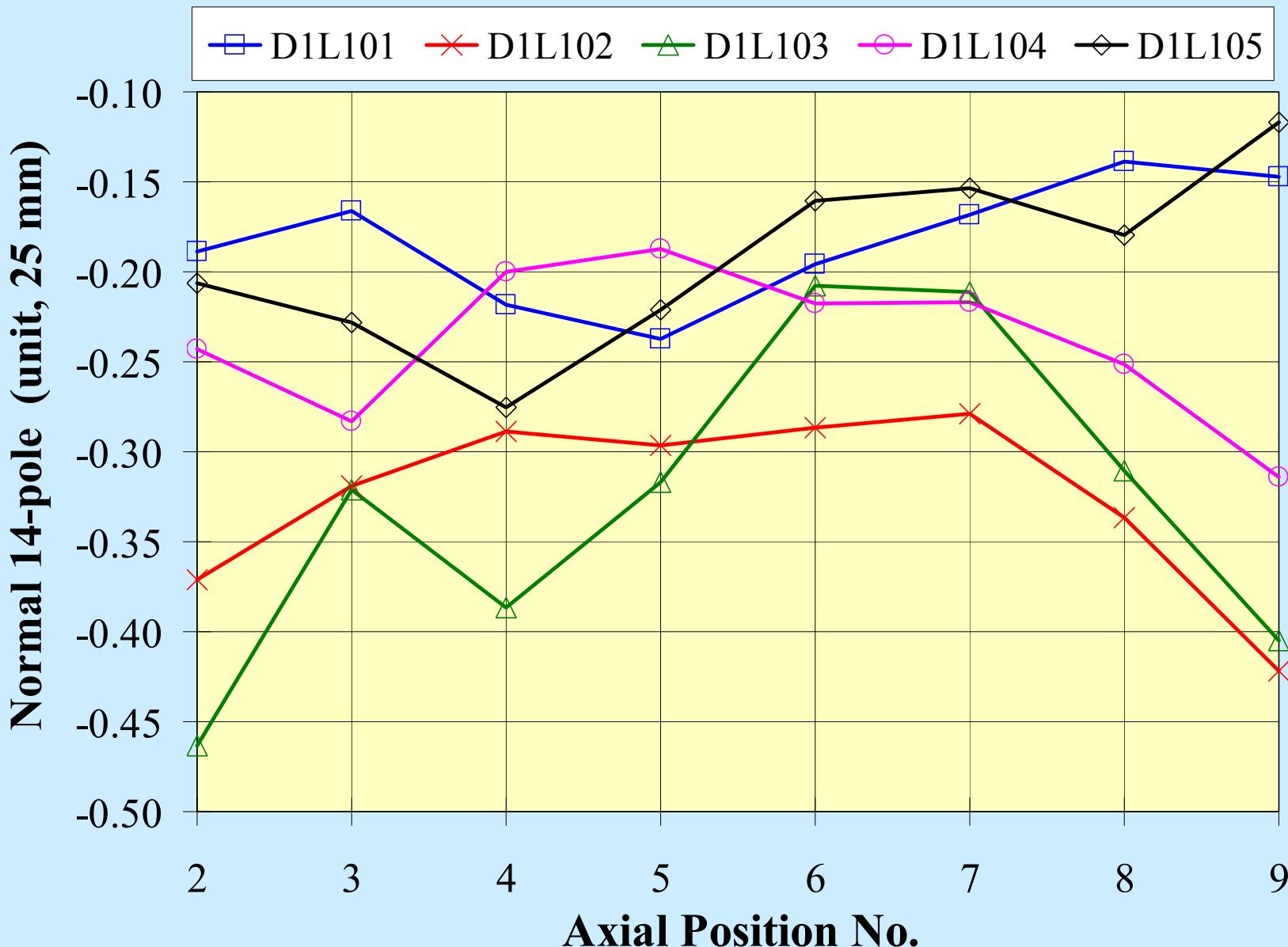
Warm Z-Scans in D1 Dipoles



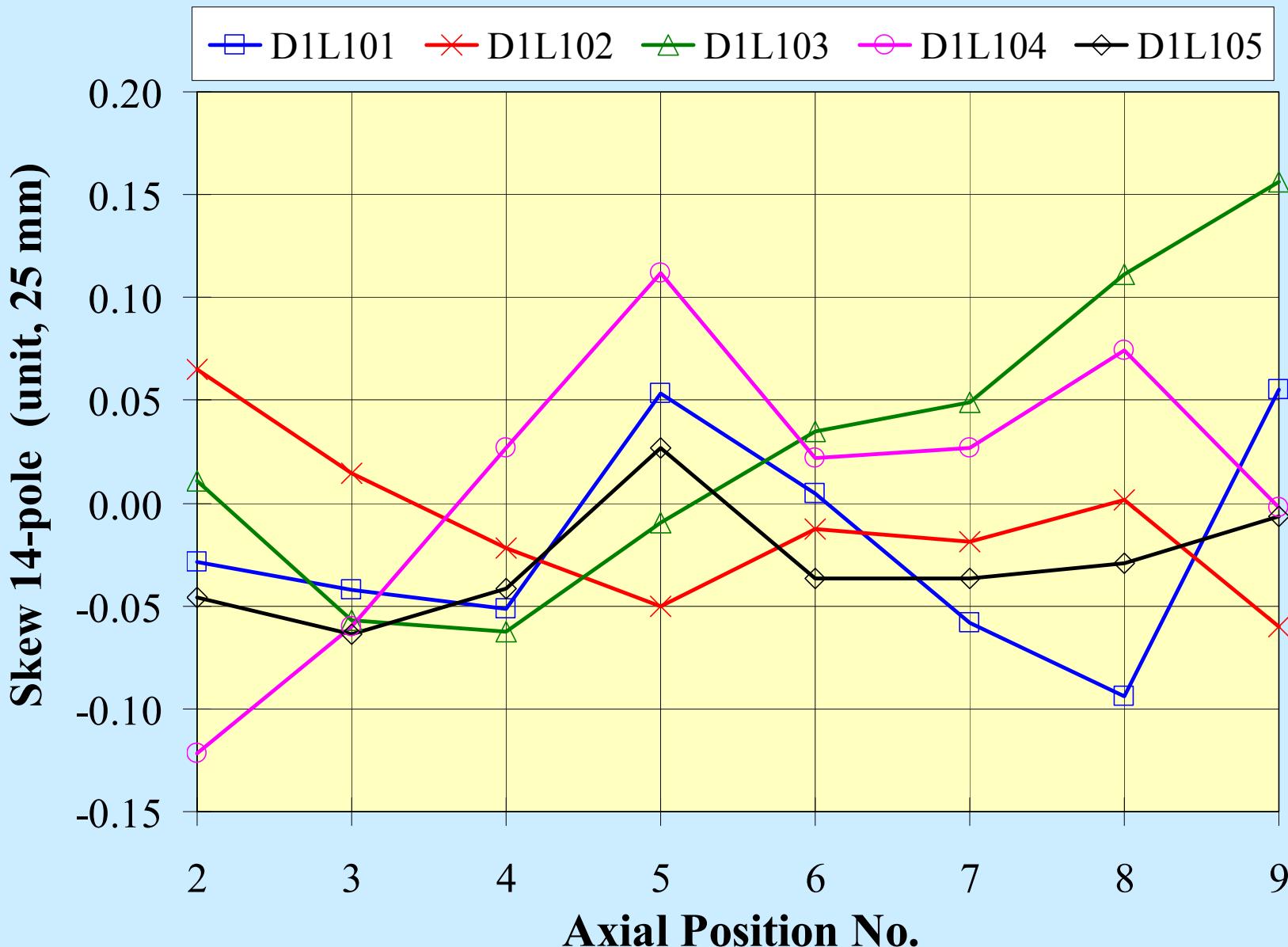
Warm Z-Scans in D1 Dipoles



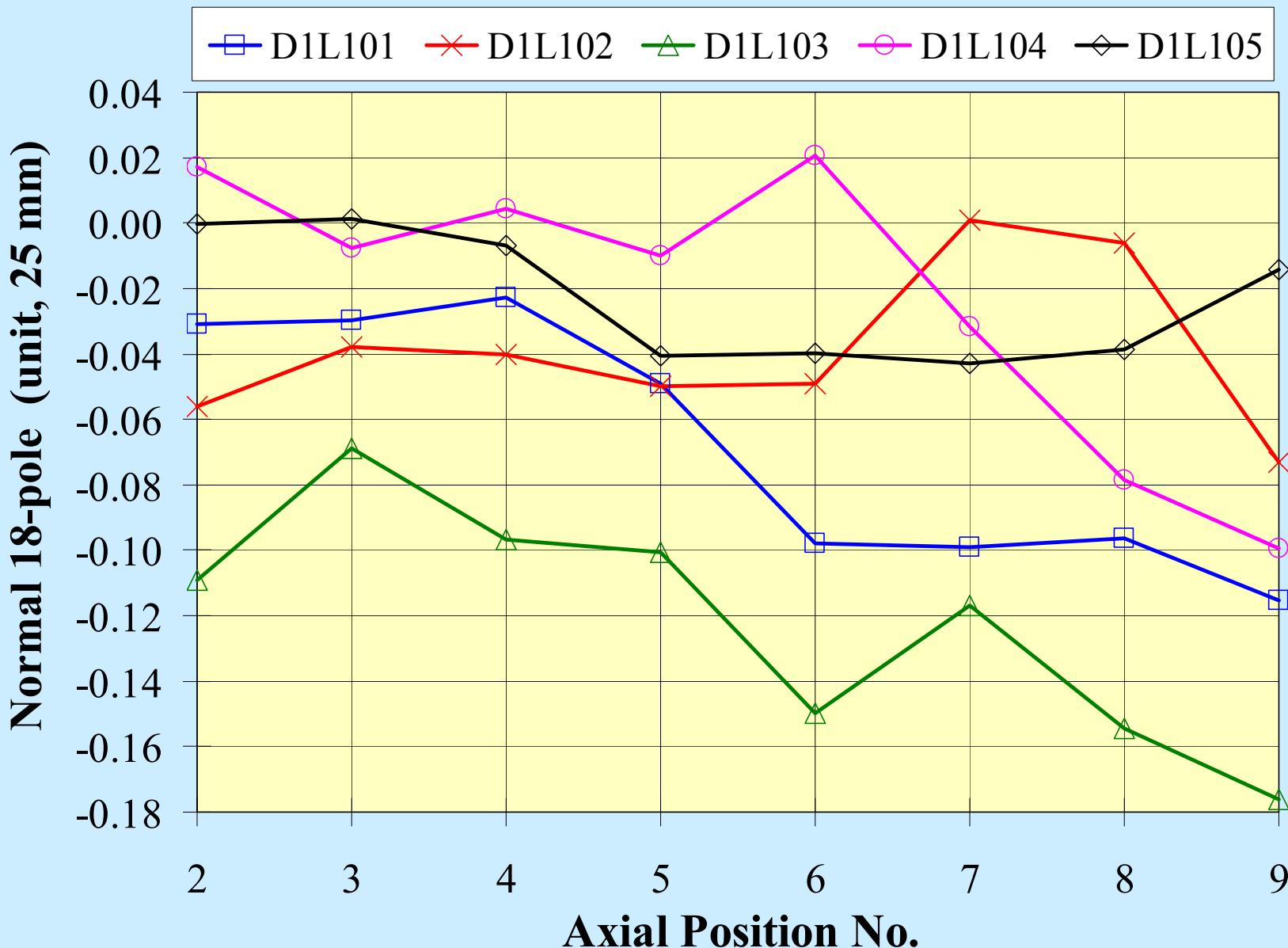
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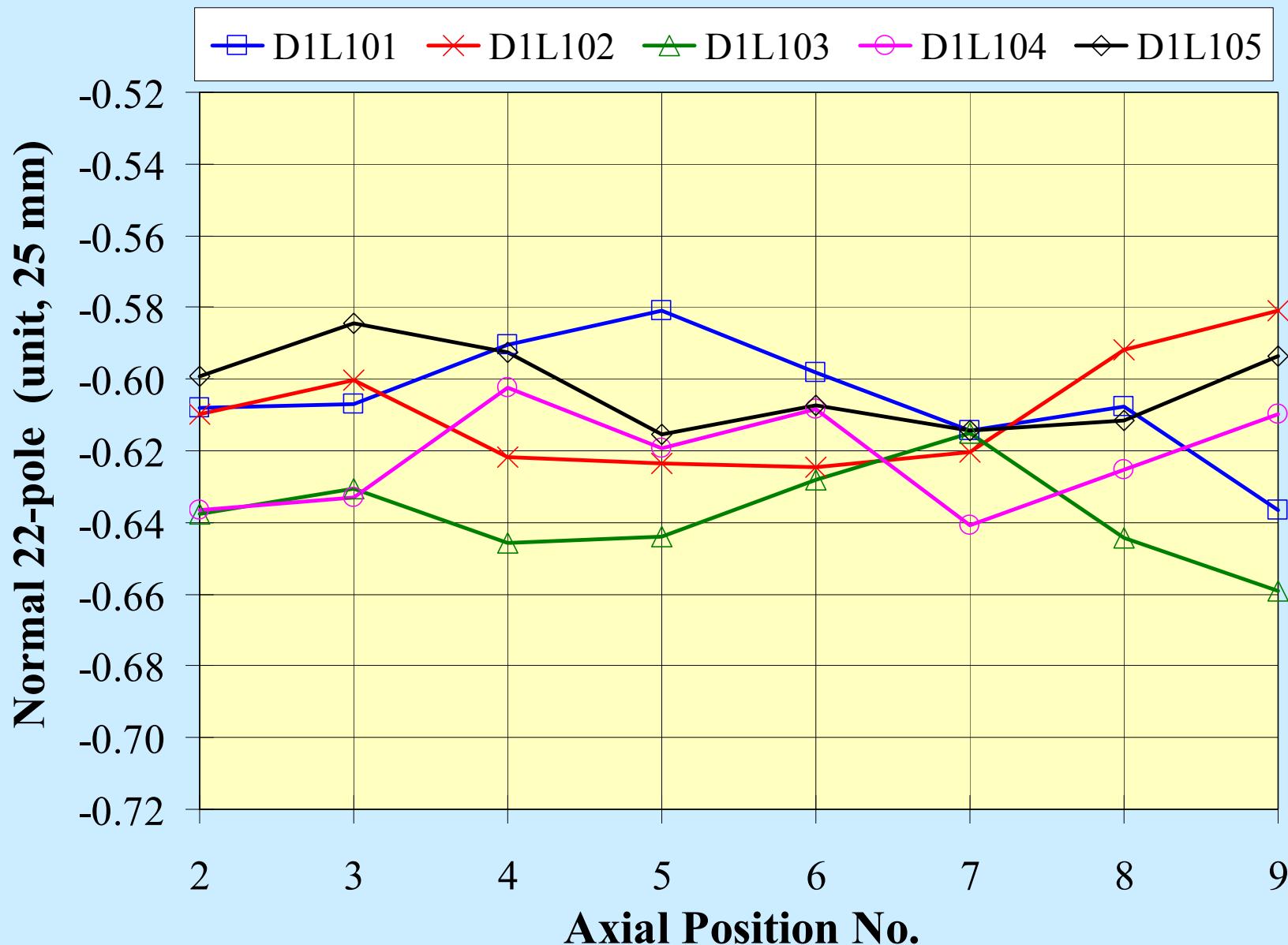
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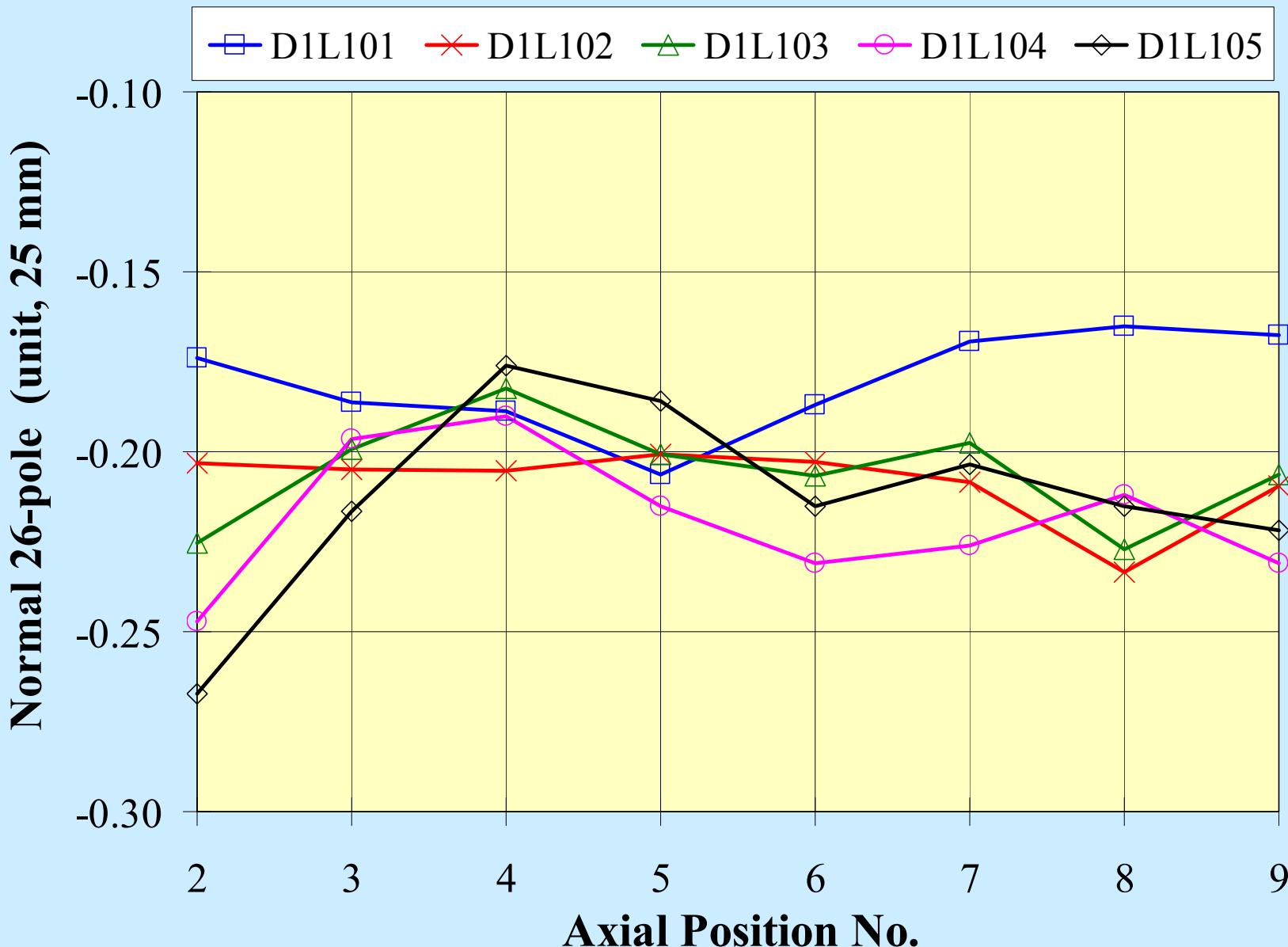
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Warm Z-Scans in D1 Dipoles



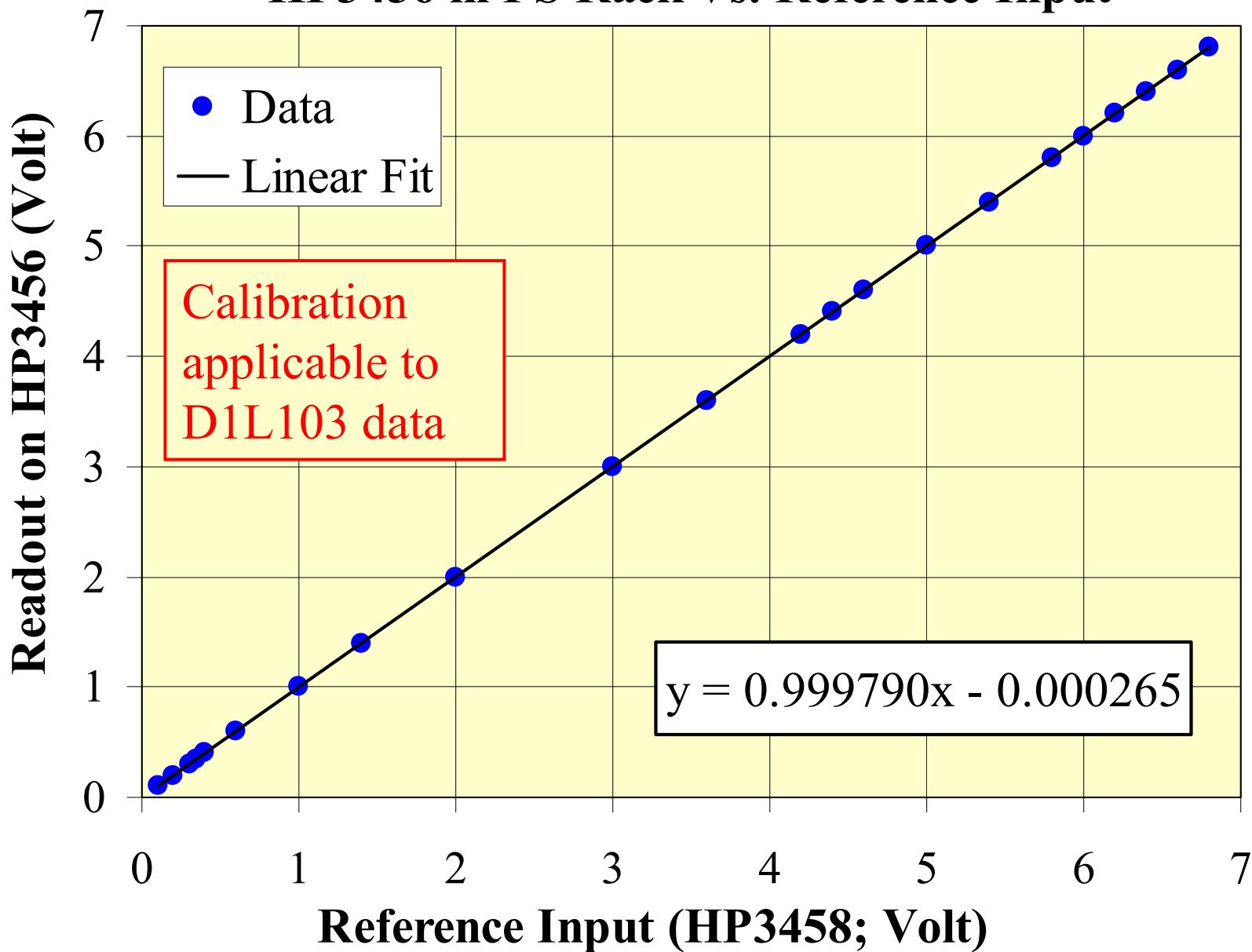
Warm-Cold Correlations

- Warm-cold correlations were derived earlier based on D1L103 cold data (body and integral), as well as the applicable RHIC data (body only).
- Subsequent cold test of D1L101 potentially provided one more data set. However, cold data in D1L101 revealed the presence of stainless steel yoke keys in this magnet, instead of steel.
- The saturation behavior of D1L101 is thus inconsistent with that expected for the other D1's
- The cold field quality in the D1's that have not been cold tested must be estimated based on warm-cold correlations derived earlier.

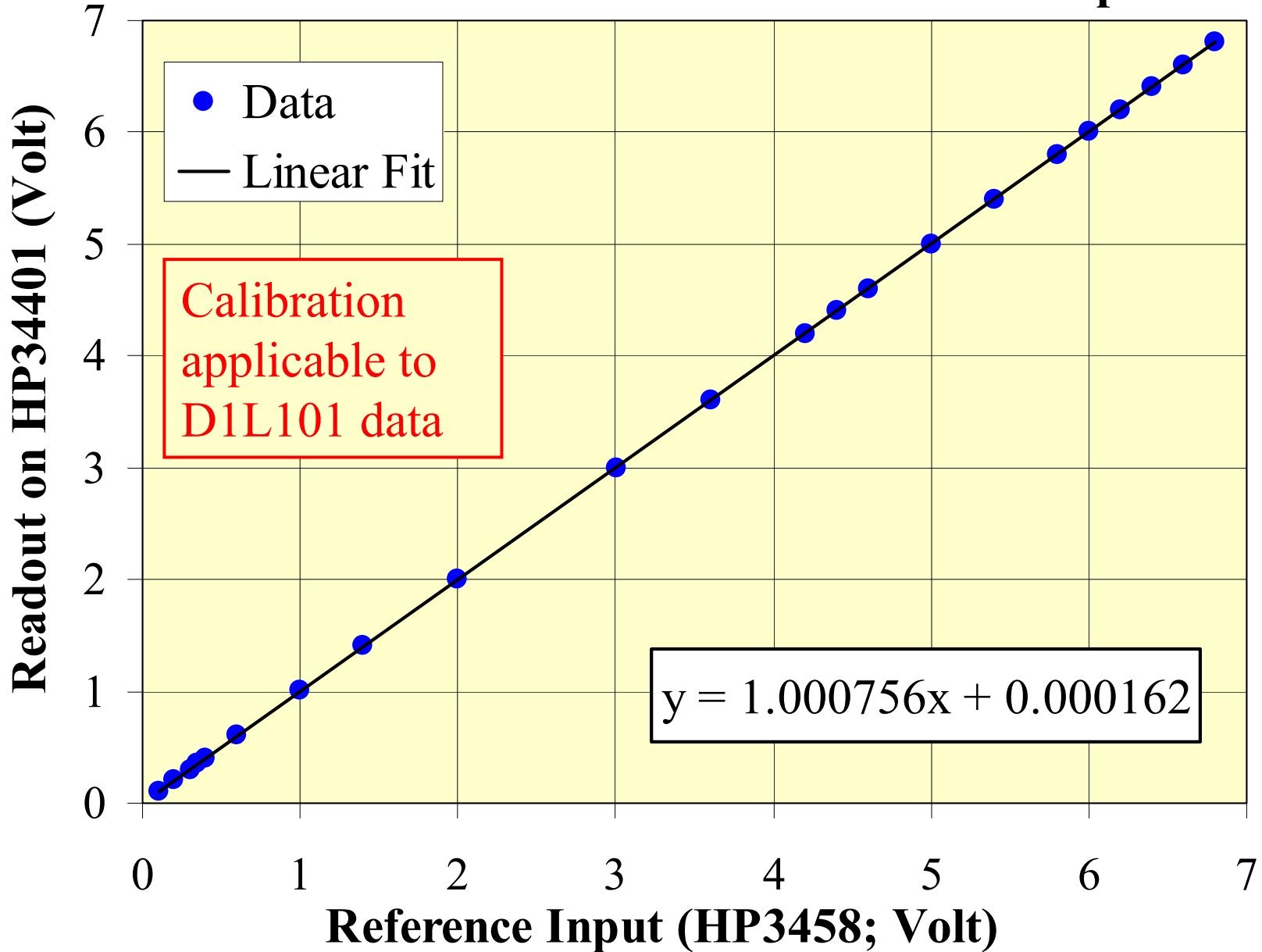
Revision to Warm-Cold Correlations

- During the twin aperture D2 test program, it was noticed that there was a small gain and offset error in the current readings.
- The current readings were calibrated during the cold test of D1L101, and corrections were applied to all the cold data.
- This changed the transfer function data in D1L103, and hence the derived warm-cold correlations.
- The correlations derived earlier for various harmonics were not affected.

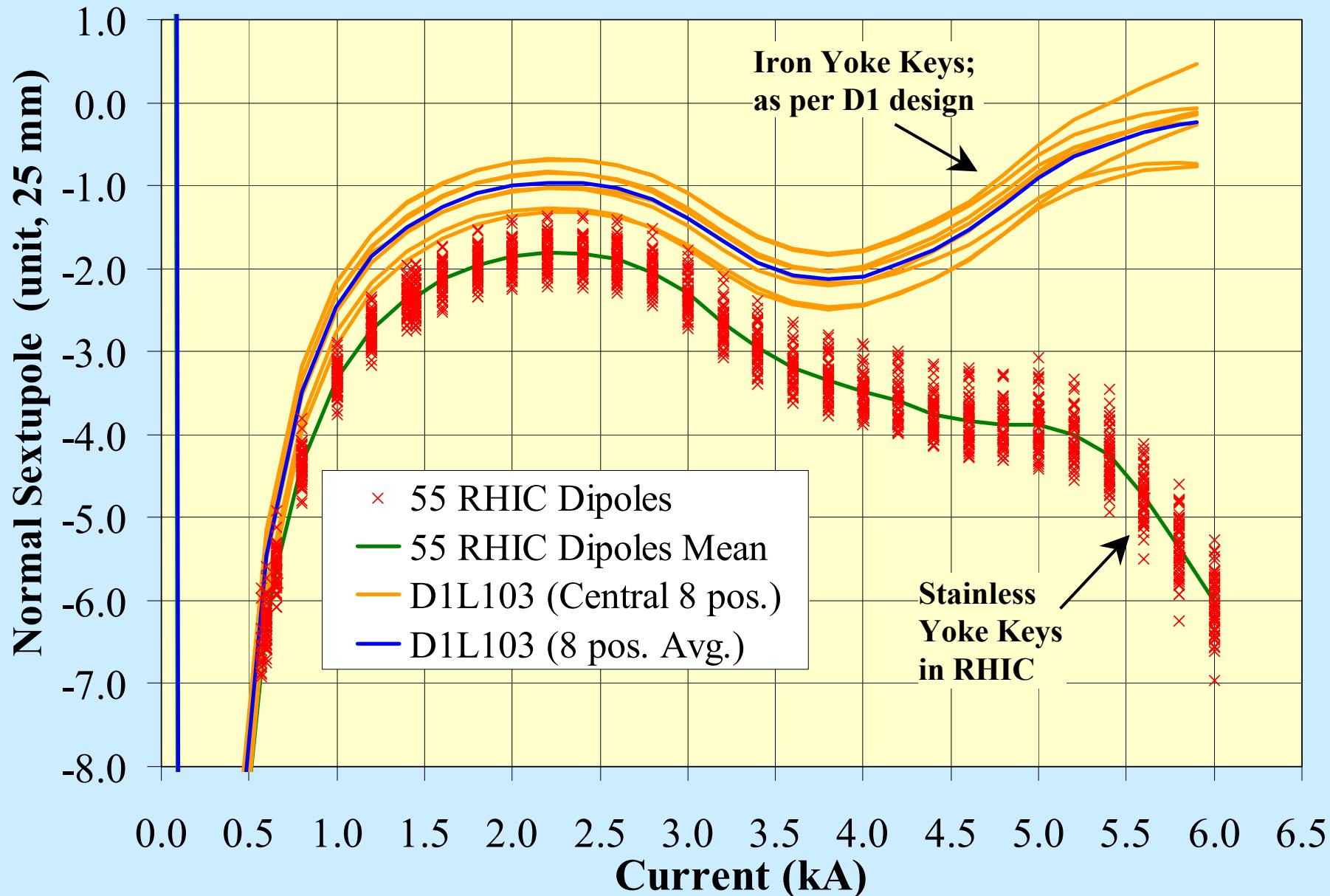
HP3456 in PS Rack Vs. Reference Input



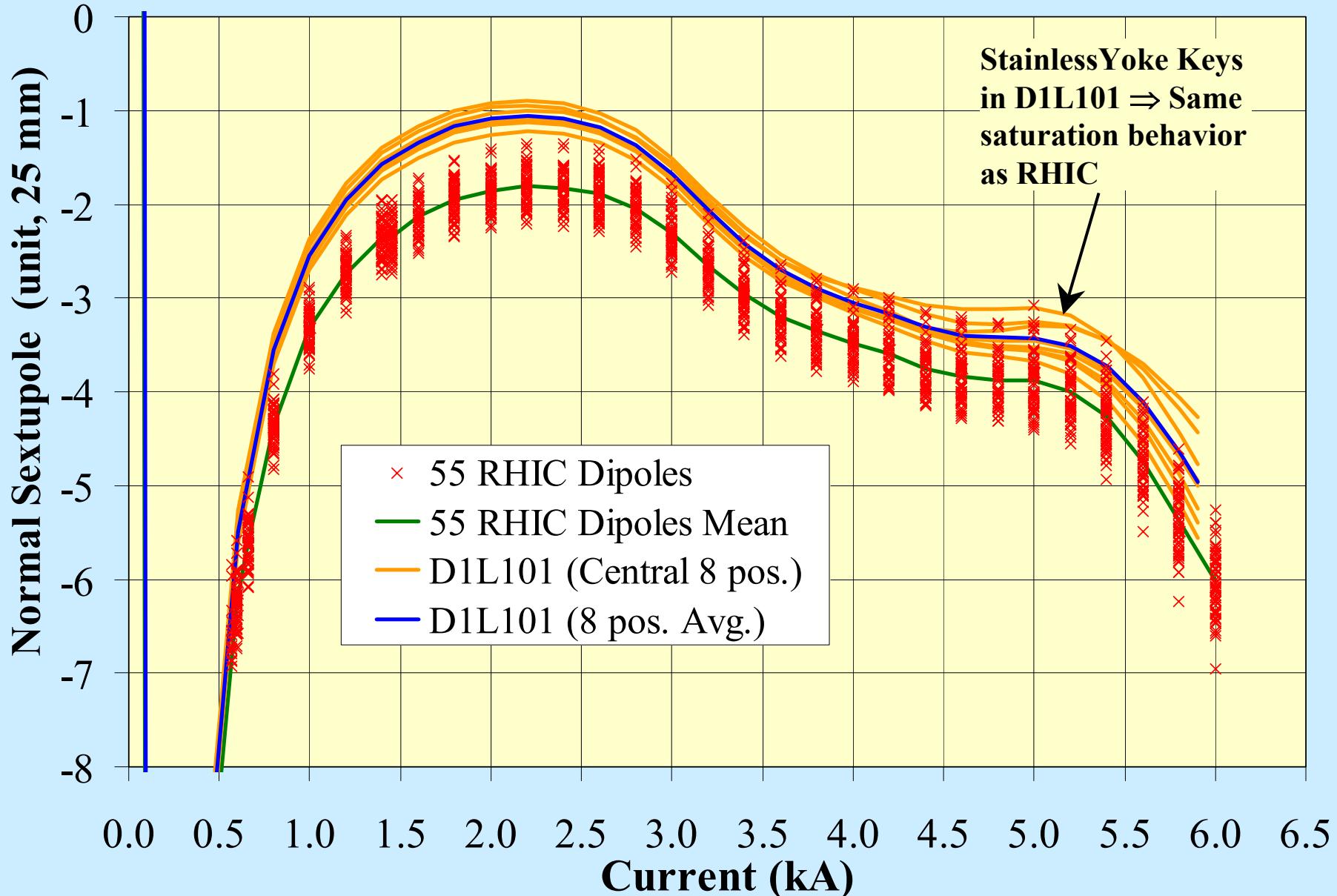
HP34401 in Meas. Rack Vs. Reference Input



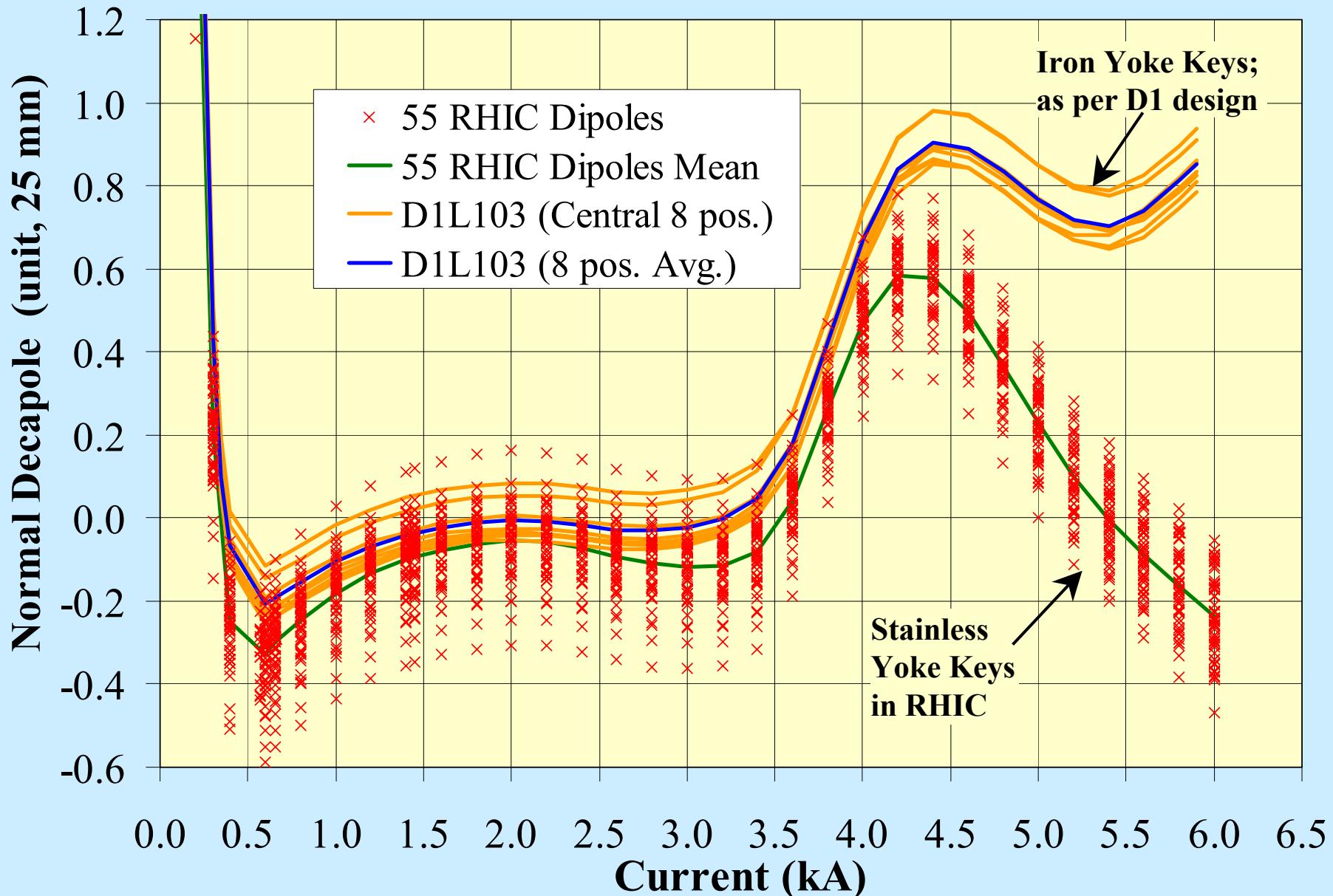
Warm-Cold Offsets in D1L103 & RHIC Dipoles



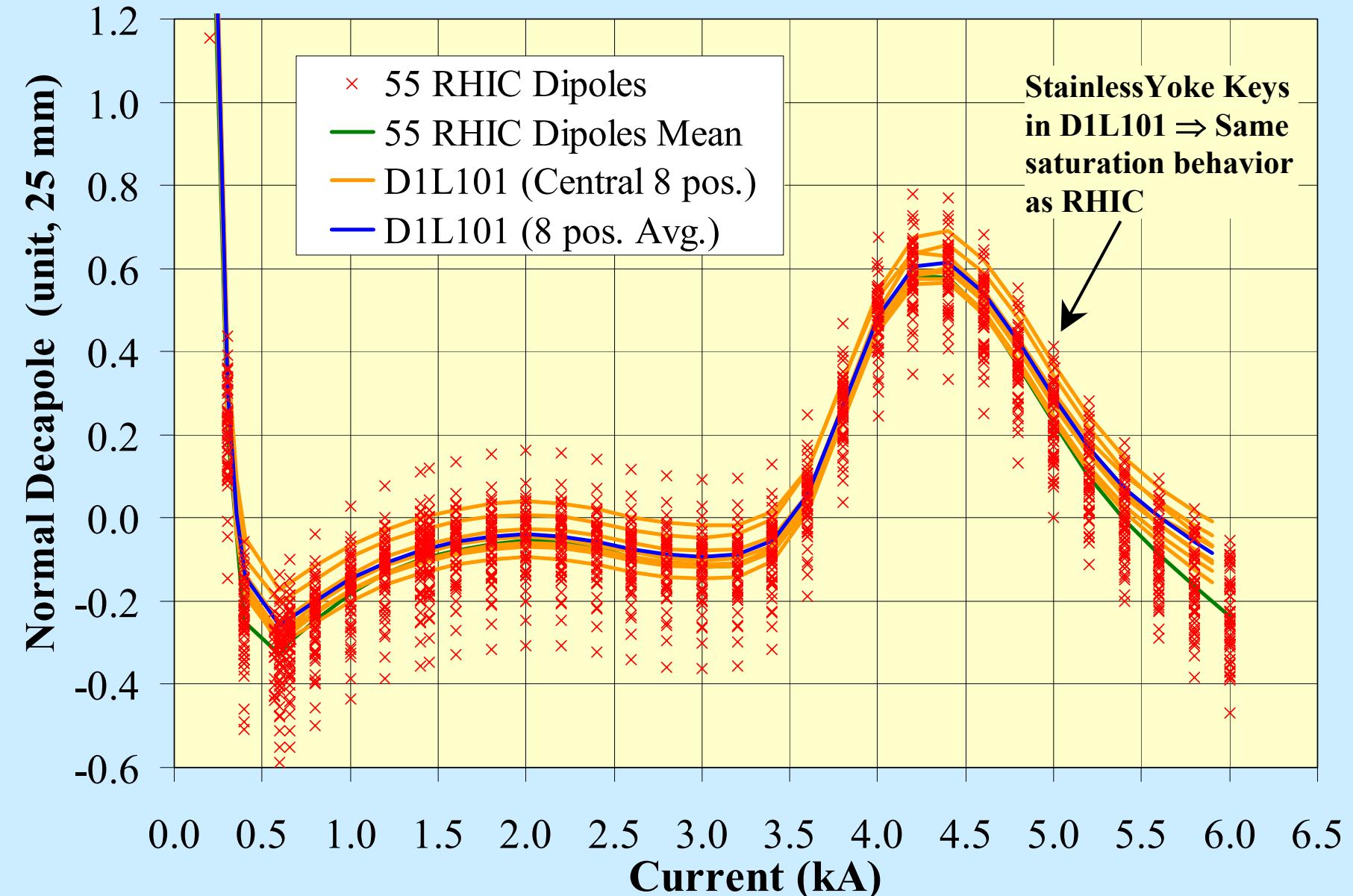
Warm-Cold Offsets in D1L101 & RHIC Dipoles



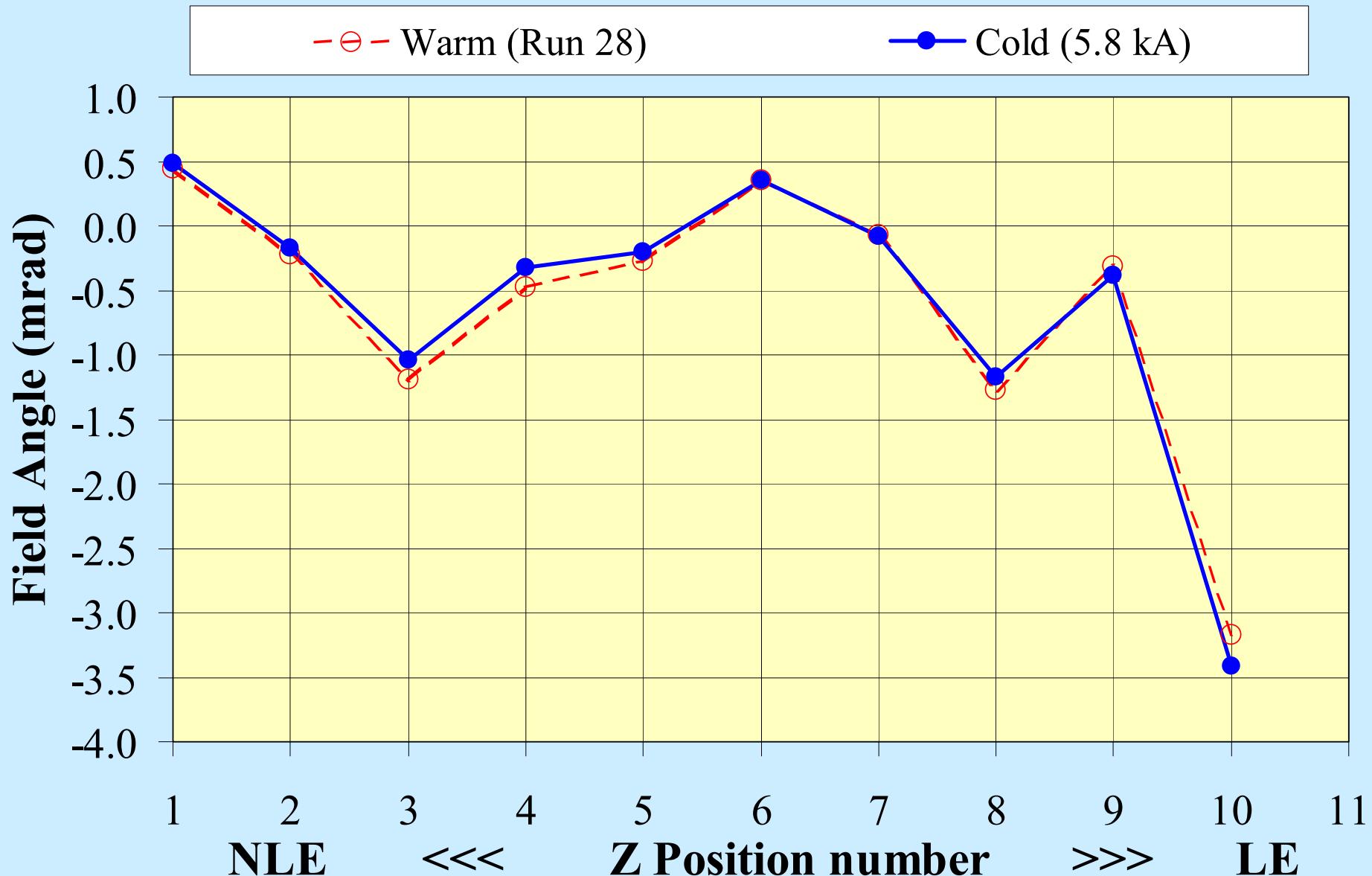
Warm-Cold Offsets in D1L103 & RHIC Dipoles



Warm-Cold Offsets in D1L101 & RHIC Dipoles



Warm-Cold Field Angles in D1L101



Summary of Integral field quality in D1 dipoles at 350A, Up ramp, 4.5 K

All data extrapolated to 4.5 K from warm measurements (except D1L101 and 103)

Actual operating temperature is 1.9K, which will impact the sextupole at injection significantly

All harmonics are in units of 1E-4 at a reference radius of 25 mm. (January 27, 2004 version)

	101_350	102_350	103_350	104_350	105_350	Mean_350	Sigma_350
ITF (T.m/kA)	6.668	6.668	6.662	6.668	6.666	6.667	0.04%
MagLen (m)	9.425	9.416	9.414	9.415	9.415	9.417	0.05%
FldAng (mrad)	-0.5	-1.2	-1.1	-0.8	-0.6	-0.8	0.3
b2	-0.49	-0.57	-0.18	-0.16	0.75	-0.13	0.52
b3	-14.86	-14.50	-16.89	-12.78	-14.96	-14.80	1.46
b4	-0.07	0.28	0.00	0.28	0.29	0.16	0.18
b5	0.38	0.48	0.29	0.68	0.59	0.49	0.16
b6	-0.02	0.01	-0.02	0.08	0.12	0.03	0.06
b7	-0.41	-0.49	-0.50	-0.40	-0.36	-0.43	0.06
b8	0.01	-0.04	0.01	-0.05	-0.01	-0.02	0.02
b9	-0.01	0.03	-0.04	0.05	0.05	0.02	0.04
b10	0.05	0.04	0.00	0.03	0.05	0.03	0.02
b11	-0.73	-0.74	-0.75	-0.76	-0.74	-0.74	0.01
a2	-0.12	2.17	-2.04	-1.54	-4.04	-1.11	2.31
a3	-0.92	-0.94	-0.71	-0.84	-0.90	-0.86	0.09
a4	-1.02	0.07	0.46	0.34	-0.45	-0.12	0.61
a5	0.21	0.07	0.28	0.07	0.22	0.17	0.10
a6	0.06	-0.08	0.11	0.34	0.08	0.10	0.15
a7	-0.09	-0.12	-0.07	-0.09	-0.14	-0.10	0.03
a8	0.02	0.00	0.07	0.05	0.01	0.03	0.03
a9	0.02	0.02	0.04	0.00	0.00	0.02	0.02
a10	0.05	0.07	0.05	0.09	0.07	0.07	0.02
a11	-0.01	-0.02	0.00	-0.01	-0.01	-0.01	0.01

Summary of Integral field quality in D1 dipoles at 5600A, Up ramp, 4.5 K

All data extrapolated to 4.5 K from warm measurements (except D1L101 and 103)

Actual operating temperature is 1.9K

All harmonics are in units of 1E-4 at a reference radius of 25 mm. (January 27, 2004 version)

	101_5600	102_5600	103_5600	104_5600	105_5600	Mean_5600	Sigma_5600
ITF (T.m/kA)	6.314	6.327	6.322	6.327	6.325	6.323	0.09%
MagLen (m)	9.439	9.431	9.430	9.431	9.430	9.432	0.04%
FldAng (mrad)	-0.5	-1.2	-1.1	-0.8	-0.6	-0.8	0.3
b2	-0.58	-0.62	-0.23	-0.22	0.70	-0.19	0.53
b3	-6.06	-2.08	-4.47	-0.37	-2.55	-3.10	2.20
b4	-0.09	0.27	-0.02	0.26	0.28	0.14	0.18
b5	0.38	1.11	0.92	1.31	1.22	0.99	0.37
b6	-0.08	0.02	0.00	0.10	0.14	0.03	0.08
b7	1.10	1.11	1.11	1.21	1.25	1.16	0.07
b8	0.01	-0.03	0.01	-0.03	0.00	-0.01	0.02
b9	-0.10	-0.06	-0.12	-0.05	-0.04	-0.07	0.03
b10	0.05	0.05	0.00	0.03	0.05	0.04	0.02
b11	-0.66	-0.68	-0.68	-0.70	-0.68	-0.68	0.01
a2	-2.37	0.18	-4.04	-3.53	-6.04	-3.16	2.29
a3	-0.90	-0.90	-0.68	-0.81	-0.86	-0.83	0.09
a4	-1.49	-0.39	0.00	-0.11	-0.90	-0.58	0.62
a5	0.23	0.07	0.28	0.07	0.22	0.17	0.10
a6	-0.05	-0.12	0.06	0.30	0.04	0.05	0.16
a7	-0.10	-0.12	-0.07	-0.10	-0.14	-0.11	0.03
a8	0.03	0.02	0.08	0.07	0.03	0.05	0.03
a9	0.03	0.02	0.04	0.00	0.01	0.02	0.02
a10	0.04	0.06	0.05	0.09	0.06	0.06	0.02
a11	-0.01	-0.02	0.00	-0.01	-0.01	-0.01	0.01

Measured and Expected (V 1.0) Harmonics in D1L Magnets

Integral Harmonics (units) at 25 mm reference radius

Harm.	Mean Values at 350A				Mean Values at 5600A				Standard Deviation			
	D1L Estim.	V 1.0		Comp.	D1L Estim.	V 1.0		Comp.	D1L Wm	Ver. 1.0		Comp.
		Min.	Max.			Min.	Max.			0.2 T	3.8 T	
b2	-0.08	-0.66	0.88	OK	-0.13	-0.54	1.05	OK	0.49	0.28	0.28	??
b3	-14.84	-16.78	-5.73	OK	-2.42	-5.27	1.86	OK	1.47	1.95	1.70	OK
b4	0.20	-0.24	0.15	??	0.19	-0.14	0.29	OK	0.12	0.08	0.08	??
b5	0.50	-0.21	1.45	OK	1.13	-0.56	1.03	??	0.15	0.40	0.39	OK
b6	0.04	-0.09	0.08	OK	0.06	-0.22	-0.02	??	0.06	0.03	0.04	??
b7	-0.42	-0.48	-0.06	OK	1.19	0.97	1.36	OK	0.07	0.10	0.10	OK
b8	-0.02	-0.07	0.00	OK	-0.01	-0.05	0.02	OK	0.02	0.01	0.01	OK
b9	0.02	0.02	0.27	OK	-0.07	-0.11	0.13	OK	0.04	0.04	0.04	OK
b10	0.03	-0.02	0.08	OK	0.03	-0.01	0.09	OK	0.02	0.02	0.02	OK
b11	-0.75	-0.71	-0.62	??	-0.69	-0.64	-0.56	??	0.01	0.02	0.02	OK
a2	-1.39	-3.77	3.59	OK	-3.38	-3.17	4.25	??	2.25	1.53	1.51	??
a3	-0.88	-1.59	-0.61	OK	-0.85	-1.86	-0.76	OK	0.12	0.17	0.18	OK
a4	-0.15	-1.03	1.27	OK	-0.61	-1.02	1.13	OK	0.68	0.42	0.41	??
a5	0.16	0.03	0.34	OK	0.16	-0.01	0.34	OK	0.09	0.06	0.06	??
a6	0.10	-0.57	0.51	OK	0.06	-0.60	0.50	OK	0.15	0.15	0.16	OK
a7	-0.11	-0.17	-0.02	OK	-0.11	-0.16	-0.05	OK	0.03	0.02	0.02	OK
a8	0.03	-0.16	0.14	OK	0.04	-0.17	0.14	OK	0.03	0.05	0.05	OK
a9	0.01	-0.01	0.05	OK	0.02	-0.02	0.04	OK	0.02	0.01	0.01	OK
a10	0.07	-0.03	0.07	OK	0.06	0.00	0.08	OK	0.02	0.02	0.02	OK
a11	-0.01	-0.03	0.00	OK	-0.01	-0.03	0.00	OK	0.01	0.01	0.01	OK